In the last decade designs over finite fields, introduced in the seventies, have received a considerable attention in view of their applications in error-correction in randomized network coding. They generalize classical designs in terms of vector spaces as follows. A design with parameters $t-(v, k, \lambda)$ over the finite field $\mathbb{F}_q$, briefly a $t-(v, k, \lambda)_q$ design, is a pair $(\mathcal{V}, \mathcal{B})$ where $\mathcal{V}$ is the $v$-dimensional vector space over $\mathbb{F}_q$ and $\mathcal{B}$ is a collection of $k$-dimensional subspaces of $\mathcal{V}$ such that each $t$-dimensional subspace of $\mathcal{V}$ is contained in precisely $\lambda$ members of $\mathcal{B}$.

In this talk I will give some insight into the problems we encountered as well as the results we obtained in determining necessary conditions on the existence of designs over finite fields with a prescribed automorphism group [1, 3].

Then I will focus my attention on the $q$-analogues of Steiner systems, that are designs over $\mathbb{F}_q$ having $\lambda = 1$. They are of particular interest because of their versatility; they indeed can be also viewed as $(t, k)$-spreads of PG($v - 1, q$) or perfect $(v, k, 2k - 2t + 2)$-constant dimension codes. Finally, we briefly discuss possible automorphisms of the putative 2-$(7, 3, 1)_q$ design, the $q$-analogue of the Fano plane [2].


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